



INFORMATION AND COMMUNICATION TECHNOLOGY ADOPTION AND ITS INFLUENCING FACTORS: A STUDY OF INDIAN SMEs

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Abstract

Purpose: The current study intends to estimate empirically the factors, which more likely influence the ICT adoption by Indian SMEs.

Methodology: Exploratory research has been applied and the current study uses a logistic regression model to estimate the data. The Database was selected as a DV to estimate the model.

Main Findings: The summary result of all the five models show that there is one significant variable that explains the ICT adoption among SMEs, i.e. complexity. This shows that the adoption of the innovative process is complex for small enterprises since these innovative processes are beyond the scope of these enterprises. The other independent variables are also significant except Trialability, Observability, Owner IS, Employee IS, Management Support, Image, etc.

Implications / Applications: The role of SMEs has become more crucial in developing nations because they have the ability to significantly improving income distribution, creation of employment, poverty eradication, as well as export growth. Technology up-gradation is the most significant factor in capacity building for enhancing competitiveness in SMEs. The main aim of innovation policy is to promote new ideas, such as products, processes, and organization techniques.

Novelty/Originality of this study: Numerous factors like social, economic, political, human and other factors that influence ICT adoption have been examined in previous literature. In addition to this, there are some other factors like technological, organizational and environmental also impact ICT adoption. In this aspect, none of the studies in previous was well-studied in Indian SMEs context. Therefore the present paper bridged this gap by examining the factors, which more likely influence the ICT adoption by Indian SMEs. Understanding this importance would enable suitable policy reviews and intervention measures that help ICT adoption.

Keywords: *Technology Adoption, SMEs, ICT, Exploratory research, logistic regression model.*

INTRODUCTION

Small and Medium Enterprises (SMEs) are recognized as priority sectors in most parts of the world. The researchers have estimated that half of the two-third of businesses in the world comprises of SMEs (Pandey and Shivesh, 2007). They contribute a huge role in the overall economic growth of the companies (Taylor and Murphy, 2004). While the economy of most nations is significantly influenced by the SMEs, in the developing nations, they are very important as they help in the creation of employment opportunities. In such kinds of economies, they play a role in income creation for the populations, and this is highly beneficial for the developing economies. In emerging countries, the manufacturing, trading and servicing sectors are largely dominated by the SMEs. The SMEs all over the world have been undergoing significant changes in response to the globalization.

The role of SMEs has become more crucial in developing nations because they are capable of improving the distribution of income, creation of employment, reduction of poverty as well as the growth of export (Pandya, 2012). The role of the SME sector in the economic development of India has taken new heights. It has emerged to be a highly vibrant and dynamic industry of the economy of Indian over the past five decades. A small industry has been one of the major areas of India's economic development strategy since its independence. There are huge contributions, which are often made by the micro, small as well as medium enterprises sector to the creation of employment opportunities, manufacturing output, as well as exports of the country is quite huge. Based on the estimates of the Ministry of MSMEs, the industry is accounting for approximately 45% of the manufacturing output and 40% of the total exports of India (Ghatak, 2010).

Application of information systems (IS) innovations in SMEs can be a micro version of bigger organizations. These give the SMEs different kinds of opportunities, which have been largely unexploited (Ramdani et al. 2009). Innovative SMEs make a significant role in the global economy in contributing to economic growth as well as technological development specifically in developing nations (Mahemba and Bruijn, 2003). SMEs have recognized the significance of Information Technology; hence they are planning to invest more in the technology-related projects in the future to achieve their strategic objectives. Technology up-gradation is the most significant factor in capacity building for improving the level of competitiveness among SMEs. Technology adoption creates a need for higher skill levels and motivates the firm to get trained (Baldwin, 1995).

Technology up-gradation is the most significant factor in capacity building for enhancing competitiveness in SMEs. The

factors that include acquiring technologies and their capacities are time, effort, cost, and risk. The information and communication technology (ICT) has the potential to allow the SMEs to expand their customer base, innovate products, enter into agreements with international partners, etc. (Dhungana, 2003). The main aim of innovation policy is to promote new ideas, such as products, processes, and organization techniques, ICT helps the organizations in the free flow of data, hence helping them to retrieve information at all times, hence enabling them to reach their desired target (Apulu and Latham, 2010). There is a positive link between firm growth and innovation and new technology. The improvements in innovation and technology in SMEs should be in a continuous manner to provide sustainable economic development. The decision-making authorities should support these improvements. A strong and effective relationship should be established between the government, researchers, and SMEs to promote sustainable economic growth (Enkela and Evis, 2011). Small manufacturing enterprises have been venturing for new innovative technologies in recent years at an increasing rate. There are a number of structural, organizational, as well as strategic factors, which help small enterprises make embrace new technologies (Julien and Raymond, 1994).

The economic growth and prosperity depend on effective commercializing new technologies and innovations and converting private firms from SMEs to developed business with a sustainable competitive advantage (Klonowski, 2012). There are various factors influencing the use of IT in firms, like support by the top management, relative advantage, organizational size as well as competitive pressures (Premkumar and Roberts, 1999). ICT investment in SMEs, mainly those linked to Internet technologies, has continued to grow since the technologies are being used rapidly to help in various business processes. The ultimate objective of innovation in an SME is to secure a return on investment and helping in its growth. The SMEs have to realize that embracing ICT is no longer just a choice. However, it is a must in the world of today, which has become highly globalized. This has been attributed to the strong waves of globalization and stiff competition, which has characterized the business climate (Selamat et al. 2013). In general, innovations are inherently more unpredictable and risky in the case of SMEs, given their small size. Hence, such SMEs require more training and support, thus inviting for more research and development on their needs, wants and perceived institution barriers (Zhu et al. 2012). The SMEs, which are oriented on technology, are stronger and quicker in shifting their market approach than firms, which are mainly on products. Further, there was no support from the management for separating the innovation of the market line from the innovation of the product line, since the combination of both the innovations has extra options and changes to grow. The SMEs, which are oriented on technology, are stronger and quicker in shifting their approach of the market than firms, which are mainly based on the product (Van Es and Der Wal, 2012).

The MSMEs play a highly important role in the socio-economic development of the country. Based on information from the MSMEs growth of the micro, small and medium enterprises for the 12th Five Year Plan of the current government (2012-2017), this industry is accounting for 45% of the overall output of the manufacturing sector and as much as 40% of the nation's total exports. Therefore, it can be noted that the MSMEs play a highly significant role in the achievement of the national objectives, as well as economic goals for the growth.

The World Bank has promised to offer an additional 5.19 million USD for the development of the MSMEs industry for them to be in a position to embrace highly efficient means of energy consumption and usage. The World Bank is also planning to make the grant via its International Bank for Reconstruction and Development (IBRD). The past five decades have seen the emergence of the MSME as a highly dynamic and vibrant industry of the economy of India. The SME industry, which consists of 36 million units, as of today, offers various employment opportunities to more than 80 million individuals. The industry through the production of over 6,000 products is contributing approximately 8% to the GDP. It also contributes 45 percent to the total manufacturing output, as well as 40 percent of the exports from the country.

The research studies on factors influencing ICT adoption by Indian SMEs are meager. Therefore, the current study intends to fill the literature gap by estimating empirically the factors, which more likely influence the ICT adoption by Indian SMEs.

LITERATURE REVIEW:

Technology up-gradation is the most significant element in capacity building for enhancing the levels of competitiveness of SMEs. The factors that include acquiring technologies and their capacities are time, effort, cost, and risk. The adoption of ICT is capable of allowing SMEs to expand their customer base, innovate products, enter into agreements with international partners, etc. (Dhungana, 2003). The management of small SMEs in Turkey assumes policies and strategies of KM as one of the significant dimensions of knowledge management. At the same time, the management also believes that the flow of knowledge and knowledge sharing is also not significant, hence hinders the outflow of knowledge from the organization (Bozbura, 2007). The perception of the SME community in adopting cloud computing is that the speed of their broadband is inadequate. Further, the absence of a stable and high-quality Internet is a key factor that hinders the migration of cloud computing. Hence, efforts are possible on a national scale and within the academic community to support the adoption of cloud computing in SMEs (Carcary et al. 2014). The cost of acquiring technology plays an important role rather than the technological expectations in delaying adopting new technologies in small and medium industries. Further, it is established that indirect network significantly influences the timing of fast Ethernet adoption, and virtual network effects generally speed up adoption. Hence, in technical systems support, the indirect network affects matters more (Corrocher, 2008). Another important aspect is that firms from different industrial sectors were capable of growing and being successful globally without reliance on local resources of knowledge. Some of the critical studies of

(Carrincazeaux et al., 2001) reported that firms appear to be less interested in the acquisition of knowledge from local resources. It was noticed that the inclination of the SMEs towards localized knowledge acquisition could be attributed to different features of the local innovation environment in association with the SMEs. It is noticed that the growth path associated with the success of the SMEs might be a highly important aspect in the observed lack of geographic proximity attributes in the knowledge acquisition (Davenport, 2005).

Further, it is argued that the SMEs' competitive advantage is always brought about by the huge role, which is played by the localized networks, as well as collective learning that makes it easy for information to be accessed. It also provides support for offsetting the size-related advantages of larger companies (Keeble et al., 1999; Capello, 1999). Albania is a transition economy, where SMEs play a significant role in supporting economic growth, providing flexibility, promoting employment, and bridging relations with European nations. There is a positive link between firm growth and innovation and new technology (Enkela and Evis, 2011). The main aim of innovation policy is to promote new ideas, such as products, processes, and organization techniques. The approach of self-reported innovation offers better results, by ensuring a broad-coverage of innovative SMEs that respond promptly to the innovation policy. Further, the performance of SMEs would be significantly different if it had not received innovation support, with the performance of SME receiving innovation support (Foreman-Peck, 2013).

Based on academic theory, firms can gain a true competitive advantage through the exploitation of intellectual knowledge. Through the effective implementation of new technologies, as well as electronic commerce, SMEs are in a position to cope with their operational environment. Through this, they are presented with numerous opportunities. Policymakers always monitor the extent of innovation. Through innovation, new products can be developed. At the same time, there are other different kinds of benefits, which are linked to labour and capital. It can also result in improvement in economic growth, the creation of more employment opportunities, and a better balance of payments for the countries besides resulting in improvement in the labour conditions among others. There is a clear connection between microeconomic issues like entrepreneurial start-ups as well as macroeconomic performance (Ionica and Razvan, 2010). Similarly, ICT helps the organizations in the free flow of data, hence helping them to retrieve information at any given point of time; hence enabling them to reach their desired target. Further, ICT also helps organizations bring in change and create a competitive advantage. It was found from the current study that, the major driver behind ICT adoption by SMEs is a competitive advantage (Apulu and Latham, 2010). There is a certain kind of positive or negative association between the knowledge networks and the implementation of technologies in SMEs. Therefore, a strong policy should be prepared for the SMEs by the regional policymakers to support them in creating and sustaining their knowledge networks (Huggins and Johnston, 2009). Small and Medium Enterprises around the globe engage in e-commerce and e-businesses to support the business operations as well as to increase their revenues. The factors, which affect the use of technology in SMEs include compatibility, relative advantage, complexity, and support by the top management, organizational readiness, pressure from the customers, partners as well as competition in Canada (Ifinedo, 2011). The development of knowledge affects the development of innovation in the business including SMEs since the key factors of success for the large and small firms are determined by the development of knowledge. The most significant determinants of effective implementation of innovation in SMEs under the conditions of the knowledge-based economy include employees, collaboration and financial resources (Ciburienne, 2009).

The small firms should put a lot of effort into installing innovation concepts all through their business by having in place departments, which are fully functional. In the process of installation of innovation, there are various changes to the structure of the organizations and the internal links in the company (Klonowski, 2012). The interaction between the team members enables the analysis of the socially construed process at the interaction level. It was found that systematic action research is supporting the translation of individuals into organizational learning through paying attention to systematic process and associating them to organizational theories (Kocher et al. 2011). Various factors influence the use of IT in companies, like top management support, relative advantage, size as well as competitive pressures (Premkumar and Roberts, 1999).

The information system (IS) adoption in SMEs cannot be a small version of large firms since IS provides SMEs with large unexploited opportunities. Despite the fact that there are numerous advantages, which are linked to IS adoption by SMEs, some firms do not go for IS adoption. The study found that there are certain influencing factors that motivate SMEs to go for IS adoption. The factors that largely contribute to influencing SME's IS adoption are relative advantage, organizational readiness, firm size, top management support, and greater ability to experiment (Ramdani and Kawalek, 2009). To achieve success in today's market, firms need to develop skills related to ICT. Therefore, the fact of achieving this development lies in certain factors, which are internal, and external in nature, that influences ICT adoption (Barba-Sanchez et al. 2007). It was evidenced that, motivating innovation leads to boosting of firms' competitiveness, which in turn leads to the growth of export sales (Nguyen et al. 2008). ICT workflow orientation is having a huge positive effect on internalization. The SMEs used ICT mainly for sharing explicit knowledge, and for leveraging combination and internalization process largely than socialization as well as externalization in which tacit knowledge is the main output (Nicolas and Acosta, 2010). Moreover, the support from the management was found to be a hindrance to new technology adoption, and resource allocation by the business managers was deficient. The other factors that affected the EC adoption were, compatibility, trialability, and observability. Therefore, there is a need for strong management support in the allocation of resources for EC adoption, and enhance knowledge and skills, which help in the adoption of technology (Seyal and Rahman, 2003).

Innovation is regarded as a key component of success in numerous areas, and it is also observed as a critical component of economic growth in Norway, which is dominated by small and medium-size business houses. Small businesses are highly likely to report market expansion or record an increase in their share of the market. At the same time, they are highly likely to report significant improvement in the levels of production or in their service levels through the use of new technologies (Robinson, 2012). SMEs should understand that the adoption of ICT is not just a choice; however, it is crucial for business success in the current globalized world. The strong waves of globalization and competition make it imperative for businesses to embrace ICT in their operations (Selamat et al. 2013). To achieve success in technology adoption, a kick-start program related to SME business support networks has been ideally placed not only in Turkey but also in other countries in the world. Further, the business owners and the top management of the businesses should be provided with information concerning some of the main benefits, which are associated with the use of new technologies (Wright et al. 2013).

There is a need for the SMEs to plan effectively for globalization as a component of their strategy with the aim of increasing their competitiveness within the highly competitive environment, but not due to reaction to venture into new markets. This effort might result in a higher level of technology-intensive companies coming up with different product lines in thrust areas (Nagayya and Rao, 2011). The SMEs of Malaysia has experienced the midst of a recession and they were hard to hit. Therefore, the government of Malaysia has recognized its importance and has implemented various policies in their assistance. One of the policies is to strengthen inter-firm-cooperation within SME clusters (Zulkifli and Char, 2010). ICT industry should provide e-business solutions to articulate potential. Besides, the products, as well as the services ought to be customized to suit the SMEs' unique needs and the needs of the vendors. Support, as well as training, ought to be given due attention. At the same time, measures ought to be put in place to create more widespread awareness concerning e-business. The other factors include the allocation of capital, and making sure that the requisite technologies are acquired (Olatokun and Bankole, 2015).

In general, innovations are inherently more unpredictable and risky in the case of SMEs, given their small size. Hence, such SMEs require more training and support, thus inviting for more research and development on their needs, wants and perceived institution barriers (Zhu et al. 2012). It is expected that the intervention of network facilitators can promote the progress of creativity, entrepreneurship, as well as social capital among the businesses. This would be more helpful for the SMEs (Yokakul and Zawdie, 2010).

Employees always face a number of changes, which include business methods and organizational culture challenges. This can influence the use of current, as well as future technologies in the firms (Poorangi et al. 2013). The level of innovativeness of the owners, their experience in IT as well as their knowledge and skills in information technology are some of the main factors, which influence the use of e-commerce by SMEs in Indonesia (Rahayu and Day, 2015). Moreover, Malaysian SMEs have also strived to be highly competitive within the business environment, which is rapidly growing. For them to improve on their competitiveness, they ought to embrace new technologies through the acquisition of IT knowledge. They should also make use of various platforms, which have been provided by the government. (Moghavvemi et al. 2012). Similarly, the lack of infrastructure of IT resources such as hardware and software needed for the implementation of the accounting system. This shows that the investment expenses is might be too high for a startup. At the same time, there is a shortage of employees with knowledge and skills to fully support the system (Chen and Hamdan, 2014). As a result, businesses should strive to ensure that they have employees with the right knowledge and skills, as this will play a significant role in improving their productivity, as well as their competitiveness. For them to improve their productivity, as well as their competitiveness in the global landscape, the owners of the SMEs ought to make huge investments in ICT as well as its components since they have generally been proven to significantly affect the performance of the organizations (Olise et al. 2014).

Similarly, SMEs face challenges in the adoption of ICT technology. The research points out the uncertainty of the SME managers concerning the general application of modern technologies (Steyn and Leonard, 2012). The innovativeness, active participation, commitment, experience as well as good knowledge of the management result in effective implementation of ICT and this makes the businesses to be in a position to realize the benefits, which are associated with them, which mainly include improvement in the level of performance of the given businesses (Machii and Kyalo, 2016). When various ICT tools, like the Internet, computers and mobile phones among others are used for the promotion of the different services or products, which are on offer by the SMEs, they will be in a better position to gain international exposure. At the same time, news concerning innovation, product invention, as well as modification will easily cross national boundaries and this will ensure that a huge customer base is reached by the businesses (Hoque et al. 2016). Finally, awareness of the citizens concerning e-commerce as well as other new e-services should be addressed with the aim of raising and promoting the different kinds of benefits, which are associated with e-commerce (Zaied, 2012).

Therefore it can be summarized that SMEs have recognized the importance of Information Technology, hence they are planning to invest more in technology-related projects in the future to achieve their strategic objectives. Technology up-gradation is the most important factor in capacity building for improving competitiveness in SMEs. ICT has the potential to allow SMEs to expand their customer base, innovate products, enter into agreements with international partners, etc. The costs related to the training given on the adoption of new technologies is more in large plants than the small plants, since they adopt more technologies, while the small firms adopt lesser technologies, Therefore, there is a positive association

between firm growth and innovation and new technology. The improvements in innovation and technology in SMEs should be in a continuous manner to provide sustainable economic development.

RESEARCH MODEL

From among all these reviewed models, the technology-organization-environment (TOE) model has been examined and validated by many previous research studies (Ramdani and Kawalek, 2009; Kuan and Chau, 2001; Premkumar and Robers, 1999; Iacovou et al., 1995). Further, the research work of (Zhu et al., 2012) has also mentioned the TOE model as the most important theory of technology adoption. This model has also been studied by (Ramdani and Kawalek, 2009). Therefore, the current study follows the model adopted by (Ramdani and Kawalek, 2009) to investigate the factors influencing technology adoption by the Indian SMEs.

Technological context

The studies, which explored the influence of technological factors on technology use by SMEs, are small in number. The theories on technological factors adopted by (Rogers, 2003 and Ramdani and Kawalek, 2009) shall be employed as the theoretical foundation for examining the influence of technological factors on the adoption of technology by the SMEs.

According to (Rogers 2003), “Perceived Relative advantage” refers to the extent to which a given innovation is regarded to be better in comparison to the idea, which it supersedes. Further, (Lee, 2004) observed that when technology is assumed to provide a relative advantage over the current position firm’s current position, and then there is a chance of its adoption. There is a positive association between relative advantage and technology adoption.

H₁: There is a positive connection between perceived relative advantage and the adoption of ICT by SMEs.

According to (Rogers 2003), “Compatibility” refers to the extent to which a given innovation is regarded to be consistent with the present values, past experiences, and the needs of the potential adopters. Further, (Premkumar, 2003) found compatibility to be an important element of technology adoption.

H₂: There is a positive link between the compatibility of innovation to the adoption of ICT by SMEs.

The extent to which a given innovation is regarded to be relatively hard to understand and use is referred to as complexity (Rogers, 2003). There is a negative association between complexity and technology adoption (Grover, 1993; Ramdani and Kawalek, 2009).

H₃: Complexity in innovation is negatively linked to the adoption of ICT by SMEs.

The extent to which a given innovation might be experimented with on a limited basis is referred to as trialability (Rogers, 2003). Studies found trialability to be positively associated with technology adoption (Kendall et al. 2001).

H₄: Trialability and ICT adoption by SMEs are positively associated.

According to (Rogers 2003), observability refers to the extent to which other people can see an innovation’s results. The greater the observability of technology, there is a chance of its adoption.

H₅: Observability in innovation is positively linked to the adoption of ICT by SMEs.

Organizational context

The work of (Premkumar, 2003) observed that the main focus of many research works in the context of SMEs is found on organizational characteristics. The current study considered top management support, employee IS, and owner IS, Innovation, Information, competitive advantage, and size as factors that influence ICT adoption by SMEs.

Firms that have owners and employees with IS experience may explore new technologies, and might want to take risks to adopt the technology (Ramdani et al. 2009). Further, (Kuan and Chau 2001) found that prior experience in technology by the organization influences the new technology adoption. Therefore, there is a positive association between employee IS, owner IS and technology adoption.

H₆: Employee IS is considered to be positively linked to ICT adoption.

H₇: Owner IS is considered to be positively linked to the adoption of ICT.

The research work of (Adamides and Karacapilidis, 2006) noted that the process of innovation needs the support of communication technologies because they are highly beneficial in ensuring efficient storage, as well as retrieval of codified knowledge. Moreover, (Bafoutsou and Mentzas, 2002) define the innovation process as to get different people together to innovate. Therefore, there is a positive link between firm innovation, as well as technology adoption.

H₈: Innovation is positively associated with ICT adoption by SMEs.

In the words of (Fitz-enz, 2001), the firm workers should have the ability to use the enterprise systems to interpret the outcomes and to make a contribution to the company. Bozbura (2007) says that employees of the organization should share

information by using effective communication channels for effective knowledge management. Moreover, he reported quick and easy access to information as an important dimension of knowledge management.

H₉: The association between information and ICT adoption is positive.

The top management support is found to be the best predictor of technology adoption in the organizational context (Jeyaraj et al. 2006). According to (Thong, 1999), top management can motivate change in the organization by communicating and reinforcing values through a planned organizational vision. In the context of SMEs, the decision-maker is more likely to be in the team of top management, hence making his/her support to be vital (Ramdani and Kawalek, 2009).

H₁₀: Top management support for innovation is positively linked to ICT adoption.

The research work of (Collins et al., 2003) reports ICT as powerful strategic and tactical tools for the firms, which can bring great competitive advantages if properly used. Similarly, (Pavic et al. 2007) state that firms have the opportunity to gain a competitive advantage from the advances made in ICT through innovation and other factors. Therefore, there is a positive relationship between competitive advantage and ICT adoption.

H₁₁: The relation between competitive advantage and ICT adoption is positive.

Firm size is assumed to be the best predictor of technology adoption by SMEs (Jeyaraj et al. 2006). A typical argument by (Levenburg et al. 2006) is that larger firms have the capability of procuring resources, skill, and experience and survive failures than the smaller firms. The association between firm size and technology adoption is positive.

H₁₂: The bigger the size of the business, the more likely ICT will be adopted by SMEs.

Environmental context

The factors, such as industry, image, pollution, and government support are regarded to significantly influence the adoption of ICT by SMEs.

The previous research works have reported that manager's choice of ICT adoption in SMEs is an attempt to manage the external image of the firm held by customers (DiMaggio and Powell, 1983; Pfeffer and Salancik, 1978; Winter et al. 2010). A firm may differentiate itself in the market by creating a different identity, managing its image by leveraging the symbolic and physical resources held in its business environment (Winter et al. 2010).

H₁₃: There is a positive relationship between the firm image and ICT adoption by SMEs.

Both industry and government play a prominent role in promoting and supporting ICT adoption by SMEs (Alam and Noor, 2009). The work of (Doig, 2000) reported that Australian governments are committed to access e-commerce, and have decided to intervene in order to make participation affordable for SMEs.

H₁₄: The association between government support and ICT adoption by SMEs is positive.

The environmental consciousness (e.g. pollution control) and degree of adoption of ICT are considered activities related to the awareness of management regarding returns on such investments. Further, firms' can control environment degradation by adopting newer technologies (Lal and Paul, 2012). They also argue that the adoption of new technologies has a positive association with environmental consciousness (e.g. pollution control).

H₁₅: There is a positive association between pollution and ICT adoption by SMEs.

The research work of (Levenburg et al. 2006) argued that a firm's industry influences ICT adoption by SMEs. Similarly, (Ramdani and Kawalek, 2009) reports that there is variation across sectors and also sub-sectors in the usage of information technology.

H₁₆: The industry sector affects the adoption of ICT by SMEs.

RESEARCH METHODOLOGY

The following section explains the research methodology used to test the formulated hypothesis, which includes research design, sampling design, and measurement.

Research Design

Exploratory research has been applied for the current study since this type of research is useful to examine the cause and effect relationship among the factors influencing the technological adoption and barriers in ICT adoption by SMEs. Hence, to conduct this research both primary, as well as secondary data have been used. The collection of primary data took place through a scheduled interview with the decision-makers in the SMEs. When carrying out the interviews, the researchers sent letters to the SMEs, which formed part of the study sample. The interview was conducted with those firms from where the invitation calls were received. The interviewees were informed that their participation in the interview is voluntary and their information shall be kept confidential. The secondary data was collected from different journals, books, magazines, and published government sources related to SMEs.

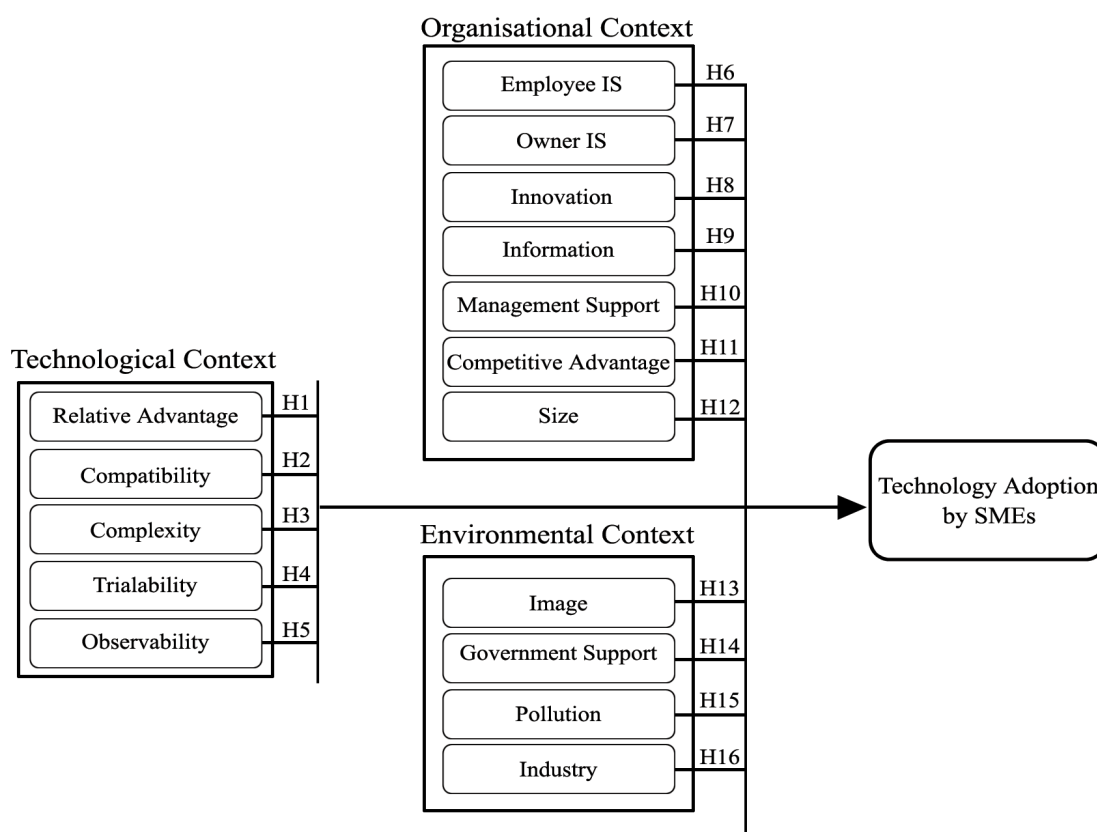


Figure 1: TOE framework of technology adoption by SMEs.

Source: [Ramdani et al. \(2009\)](#)

Sample Design

The current study has used a stratified random sampling method since the nature of the population is finite. This method allows classifying the heterogeneous population into a homogeneous sub-set. Basing on this, the SMEs that are registered with DIC are considered for this study. In estimating the sample, a precision rate of (+/-) 5% has been desired, i.e. the acceptable rate of error for the current study is equal to 5%. Therefore, based on the standard deviation of a population, a random sample of 300 was selected in the state of Maharashtra.

The sample size consists of those major districts where the SMEs are situated. Therefore, a sample size of 50 was considered for each district. The following table 1 shows the sample size of six major districts.

Table 1: Sample Size of Six Major Districts of Maharashtra

S.No.	Major Districts	Sample Size
1.	Mumbai	50
2.	Nashik	50
3.	Dhule	50
4.	Jalgaon	50
5.	Pune	50
6.	Aurangabad	50
	Total	300

The industries' selection for the current study is very small, i.e. among 53,070 industries in Maharashtra, only 300 SMEs were considered as a sample.

Measurement

The table presents the measures of dependent and independent variables. A number of the measures are taken from past research works, and their validity and reliability have been shown.

Concept	Operational measure	Sources
<i>Dependent Variable</i>		
Database		
(SMEs ICT adoption)	Dummy Variable	Ramdani et al (2009)
	1 = has database	
	0 = doesn't have database	
<i>Independent Variables</i>		
Perc. Relative Adv. (PRA) Multi-items		Rogers (2003); Ramdani et al (2009)
Compatibility (COMP)		Grover (1993) Ramdani et al (2009)
Complexity (COMPLEX)		Ramdani et al (2009)
Trialability (TRIAL)		Kendall et al (2001) Ramdani et al (2009)
Observability (OBSERV)		Rogers (2003) Ramdani et al (2009)
Employee IS (EMP IS)		
Owner IS (OWNER IS)		Kuan and Chau (2001) Ramdani et al (2009)
Innovation (INNOV)		Bofoutsou and Mentzas(2002)
Information (INFORM)		Bozbura (2007)
Management Support (MGT SUP)		Thong (1999) Jeyaraj et al (2006)
Competitive Advantage (COM ADV)		Collins et al (2003) Pavic et al (2007)
Size (NO EMPLOYEE)		Jeyaraj et al (2006) Ramdani et al (2009)
Image (IMAGE)		Winter et al (2010)
Government Support (GOV SUP)		Alam and Noor(2009)
Pollution (POLUTION)		Lal and Paul (2012)
Industry (INDUSTRY)		Lavenburg et al (2006) Ramdani et al (2009)

Validity and Reliability

The test of validity and reliability is carried out to ensure the accuracy of the measurements. Validity can be defined as how accurately the factors are measuring what they should measure. On the other hand, reliability can be defined as consistency in the obtained results. According (Ghauri and Gronhaug 2002; Ramdani et al 2009), a number of criteria may be used for judging construct validity. The operational measures otherwise known as factors were taken from the previous research works. The reliability of these factors was tested using Cronbach's α . The construct results are given in Table 2.

Table 2: Results showing the validity and reliability of factors of ICT adoption

Factor	Number of Items	Cronbach's α
Perceived Relative Advantage	4	0.72
Compatibility	3	0.73
Complexity	4	0.76
Trialability	3	0.58
Observability	4	0.66
Employee IS	3	0.53
Owner IS	2	0.41

Innovation	3	0.65
Information	3	0.69
Image	2	0.53
Competitive Advantage	3	0.71
Management Support	5	0.77
Government Support	5	0.93
Pollution	2	0.87

The results given in Table 2 indicate that 7 out of 14 variables are having Cronbach's alpha above 0.7 as suggested by (Nunnally, 1978), while the remaining 7 variables are below 0.7 and 3 of the variables range from 0.4 to 0.55. The variables Perceived Relative Advantage, Compatibility, Complexity, Competitive Advantage, Management Support, Government Support, and Pollution have a Cronbach's alpha of above 0.7. The research work of (Ramdani et al. 2009) has reported similar values. The remaining variables have different Cronbach's alpha ranging from 0.41 to 0.69. Among them, the variable Owner IS has an alpha of 0.41, the Employee IS and Image, have an alpha of 0.53, and lastly, the Trialability, Innovation, Observability, and Information have alphas of 0.58, 0.65, 0.66 and 0.69. The values for these variables are low due to the small size of the sub-set. Spiliotopoulou (2009) reported that the low size of the coefficient alpha may not often point out problems within the construction of the tool; while large sizes of the alpha do not always indicate reliability. Further, (Lane and Ziviani, 2003) have also reported low alpha values of 0.40 and related the result to a small sample size.

The current study uses a logistic regression model to estimate the data. As reported by many researchers among the assumptions of linear models, the assumption that the residuals are normally distributed is the most important one. The dependent variable is an outlier to this assumption, but it should be continuous, unbounded and should be measured on a ratio or interval scale. Moreover, the categorical variables are victims of this assumption, since it is impossible to get normal residuals from a model consisting of categorical variables. Therefore, there is a number of models to estimate the categorical variables, and a logistic regression model is one of those models.

The logistic regression model is much similar to the normal linear regression model, while a logit link function makes a big difference. A logit link function is a function of the mean of the response variable Y that we use as the response instead of Y itself. Therefore, when the Y variable is categorical, we use the logit of Y as the response in our regression equation. The logit function is the log-normal of the odds, i.e. Y equals one of the categories, which are coded as 0 and 1. The logit of Y

$$\text{Ln} \left[\frac{P}{1-P} \right]$$

is written as, where P is defined as the probability that Y is equal to 1. According to (Premkumar, 2003), with the usage of the logistic regression model, we maximize the likelihood of firm adopting ICT innovations.

Based on the TOE framework of ICT adoption by SMEs, the logistic regression model for a particular data point *i* is estimated as follows:

$$\text{Ln} \left[\frac{P_i}{1-P_i} \right] = \alpha_0 + \beta_1 \text{PRA}_i + \beta_2 \text{COMP}_i + \beta_3 \text{COMPLEX}_i + \beta_4 \text{TRIAL}_i + \beta_5 \text{OBSERV}_i + \beta_6 \text{EMPIS}_i + \beta_7 \text{OWNERIS}_i + \beta_8 \text{INNOV}_i + \beta_9 \text{INFORM}_i + \beta_{10} \text{MGTSUP}_i + \beta_{11} \text{COMADV}_i + \beta_{12} \text{SIZE}_i + \beta_{13} \text{IMAGE}_i + \beta_{14} \text{GOVSUP}_i + \beta_{15} \text{POL}_i + \beta_{16} \text{Industry}_i + \varepsilon_i$$

The current study found certain variables of technology adoption, such as Database, Internet, LAN, Management Information System (MIS), and Decision Support System (DSS) to include as a Dependent Variable (DV) in the logistic regression. Among these variables, the Database, which is Logit of Y as given in the above equation is the DV. The study has also tested the model with the help of other variables. The results of these model tests have shown most of the Independent Variables (IV) as insignificant, and moreover the R² (Cox & Snell and Nagelkerke) is small, i.e. ranging from 0.16 to 0.30, while the opposite was true with the Database. Therefore, the Database was selected as a DV to estimate the model.

As discussed earlier, the current study has estimated the model with the help of logistic regression to study the factors influencing the adoption of ICT in SMEs. Further, the robustness of the model has been tested with the help of the forwarding Wald logistic regression model. The robustness of the results could also have been tested by dropping certain observations arbitrarily as suggested by (Hair et al. 1998 and Ramdani et al. 2009), but the current study has not ventured for observation dropping.

Furthermore, the goodness of fit is explained through the Hosmer and Lemeshow test. This test of fitness has turned out to have serious problems. The result of the fitness test depends largely on the number of groups. The data related to the current study has been divided into 10 groups to calculate the goodness of fit test.

EMPIRICAL RESULTS

This section deals with the empirical results. The factors affecting technology adoption by SMEs are examined with the help of Database, DSS, Internet, MIS, and LAN. The result where the Database¹ is the dependent variable is presented here.

Table 3: Results showing ICT Adoption by SMEs

Independent Variables	β	Wald	Sig.	Exp(β)
PRA	0.22	3.59	0.058	1.24
COMP	0.28	3.81	0.051	1.32
COMPLEX	-0.16	5.99	0.014	0.85
TRIAL	-0.12	2.01	0.156	0.88
OBSERV	0.05	0.44	0.505	1.05
EMPIS	-0.11	0.96	0.325	0.89
OWNERIS	0.04	0.12	0.734	1.05
INNOV	-0.35	8.09	0.004	0.70
INFORM	0.22	5.82	0.016	1.25
MGTSUP	0.03	0.34	0.562	1.03
COMADV	-0.17	3.19	0.074	0.85
SIZE	0.06	8.72	0.003	1.06
IMAGE	-0.03	0.06	0.803	0.97
GOVTSUP	0.05	3.27	0.071	1.05
POL	-0.02	0.06	0.813	0.98
Industry	0.01	0.00	0.990	1.00
χ^2 (df) final model	139.43***			
χ^2 (df) Hosmer and				
Lemeshow Test	14.04*			
Cox & Snell R ²	0.37			
Nagalkerke R ²	0.54			
Classification Table				
Predicted				
DATABASE				
Observed		0	1	% correct
DATABASE	0	56	29	65.9
	1	26	188	87.9
Overall Percentage				81.6

***Significant at the 0.01 level, *Significant at the 0.10 level

The results of the estimated model where 'database' is the dependent variable are given in Table 3. The independent variables, such as relative advantage, compatibility, complexity, innovation, information, competitive advantage, size, and government support are significant. The practical relative advantage is significant at more than a 5% significant level. The exponential beta is 1.24, while the Wald statistic is 3.59. Similarly, the compatibility is significant at 5% level of significance. The exponential beta is 1.32, while the Wald statistic is 3.81. Further, the complexity is significant at 1% level of significance. The exponential beta is 0.85, while the Wald statistic is 5.99. The trialability is insignificant. The exponential beta is 0.88, while the Wald statistic is 2.01. Similarly, Observability is also insignificant. The exponential beta is 1.05, while the Wald statistic is 0.44. The employee IS is also insignificant. The exponential beta is 0.89, while the Wald statistic is 0.96. Furthermore, the owner IS is also insignificant. The exponential beta is 1.05, while the Wald statistic is 0.12. Further, the innovation is significant at 1% level of significance. The exponential beta is 0.70, while its wald statistic is 8.09. Similarly, the information is significant at less than a 5% significance level. The exponential beta is 1.25, while its wald statistic is 5.82. Moreover, management support is insignificant. The exponential stands at 1.03, while its wald statistic is 0.34. Further, the competitive advantage is significant at less than a 10% significance level. The exponential beta

¹The results where the other elements such as DSS, Internet, MIS, and LAN are dependent variables will be produced on demand.

is 0.85, while its wald statistic stands at 3.19. Moreover, the firm size is significant at 1% significant level. The exponential beta is 1.06, while its wald statistic stands at 8.72. Further, the image is insignificant. The exponential beta is .97, while its wald statistic stands at 0.06. The government support is significant at less than a 10% significance level. The exponential beta is 1.05, while its wald statistic is 3.27. Similarly, pollution is insignificant. The exponential beta is 0.98, while its wald statistic is 0.06. Lastly, the industry is also insignificant. The exponential beta is 1, while the Wald statistic is 0.

The chi-square is significant at <0.01 level and Nagarkerke R^2 is 0.54. Further, the overall classification percentage is 81.6 percent.

DISCUSSION OF THE RESULTS

The result presented in Table 3 shows the relative advantage, compatibility, complexity, innovation, information, competitive advantage, firm size, and government support as significant variables explaining the ICT adoption by the SMEs. The small enterprises perceive the adoption of innovation as a better idea to exploit the available business opportunities. The advantages derived are a reduction in turnaround time, an increase in the speed of transactions, immediate access to information, error reduction in data entries, etc. (Premkumar and Roberts, 1999). This is consistent with the previous studies of (Rogers, 2003; Grandon and Pearson, 2004; Lee, 2004; Ramdani et al. 2009; Lin and Ho, 2011).

The significance of compatibility shows that the infusion of technology seems to be compatible with the SME's infrastructure and culture. The extent to which the technology is consistent with the values and beliefs, needs, and previous experiences (Rogers, 2003). Premkumar and Robers (1999) found technology adoption as a significant source that brings change in business practices and also resistance to change. This is also consistent with the previous studies of (Mbizi et al. 2013; Ramdani et al. 2009)

Similarly, the significance of complexity shows that the adoption of the innovative process is complex for small enterprises since these innovative processes are beyond the scope of these enterprises. The complexity arises not only due to scarce financial resources but also due to a lack of technical knowledge and skills among the employees of the organization. Moreover, the resources available with the small firms are limited compared to the larger organizations. This is the extent to which the technology adoption is presumed as difficult to adopt and use (Rogers, 2003). Further, there is an increased risk in the technology adoption process, since the complex process of technology adoption is difficult to implement successfully (Premkumar and Roberts, 1999). This is consistent with the previous studies of (Degraff and Quinn, 2007; Ciemleja and Lace, 2008; Abouzeedan, 2011; Lin and Ho, 2011; Varis and Littunen, 2012).

The significance of the innovation factor shows that the small firms are inclining towards the adoption of ICT. They presume to adopt the innovation to be helpful in their growth and survival. Further, it was evidenced that the small enterprises due to their technological innovations experience improved economic performance. This is consistent with the works of (Abouzeedan, 2011; Ifinedo, 2011; Varis and Littunen, 2012; Selamat et al. 2013). Further, the technology adoption improves the efficiency of information inside the firm hence increasing the transaction speed between different types of customers (Lowik et al. 2012). Moreover, effective management of information is a difficult task in terms of a knowledge-driven economy (Susanne, 2012).

The significance of competitive advantage shows that the small enterprises by ICT adoption gain a competitive advantage over the other firms over their rivals by enhancing the product quality and apply new technologies thereby improving their business performance. When SMEs are at the growth stage, their main purpose of technological innovation is to maintain a competitive advantage, hence try to explore innovation strategy rather than a defensive strategy (Linzhou and Yunfei, 2015). The small firms facing competition use those technologies that have the necessary infrastructure (Premkumar and Roberts, 1999). The result is consistent with the previous studies of (Alam and Noor, 2009; Yokakul and Zawdie, 2010; Varis and Littunen, 2012; Pandya, 2012; Susanne, 2012; Abouzeedan, 2011; Park and Rhee, 2013; Hamid and Tasmin, 2013). The government and industry working under it play a prominent role in promoting and supporting ICT adoption in small enterprises. The technological development assistance funds as a proxy measure of the government's financial support are very useful in technological innovation and demonstrate an increase in the business performance of the SMEs. The significance of government support shows that the government is encouraging SMEs in the adoption of new technologies by promoting low-cost technology solutions that are designed specifically for SMEs. This is consistent with the previous studies of (Vinig et al. 1998; Doig, 2000; Alam and Noor, 2009).

But the result presented by the current study is contrary to what should have happened otherwise, i.e. the management support is insignificant. The contrary result might be due to several reasons, such as the top management might be assuming ICT adoption as a costly affair, since technology installation, hiring skilled personnel, etc. incurs a cost to the firm. The result is inconsistent with the previous research studies (Premkumar and Roberts, 1999; Jeyaraj et al. 2006; Ramdani et al. 2009). Lack of ICT user skills, as well as awareness among the main stakeholders generally undermines the adoption of ICT. This also influences the performance of the SMEs and therefore needs investment in training, awareness as well as sensitization to ensure effective integration and implementation of the required systems in the business environment so as to live valid as well as high-quality output. Support of the top management of the businesses has also been established as one of the leading factors, which influences the adoption of ICT, and this also affects the overall performance of the SMEs. Hence, it is essential for the managers to have the right kind of information concerning the

different kinds of technologies, as well as business dynamics, which affects them. This will ensure that they support the given technologies, and this will ensure an improvement in the performance of the businesses. New innovations have the ability to boost business processes, as well as the process of decision-making.

CONCLUSION

The role of SMEs has become more crucial in developing countries, as they have the potential to improve income distribution, employment creation, poverty reduction, and export growth. Technology up-gradation is the most important factor in capacity building for improving competitiveness in SMEs. The main aim of innovation policy is to promote new ideas, such as products, processes, and organization techniques. The current study intends to estimate empirically the factors, which more likely influence the ICT adoption by Indian SMEs.

The summary result of all the five models shows that there is one significant variable that explains the ICT adoption among SMEs, i.e. complexity. Similarly, the independent variables, such as innovation and size are also significant among all the models, except the Internet. The result presented in Table shows the relative advantage, compatibility, complexity, innovation, information, competitive advantage, firm size, and government support as significant variables explaining the ICT adoption by the SMEs. The small enterprises perceive the adoption of innovation as a better idea to exploit the available business opportunities. The significance of compatibility shows that the infusion of technology seems to be compatible with the SME's infrastructure and culture. Similarly, the significance of complexity shows that the adoption of the innovative process is complex for small enterprises since these innovative processes are beyond the scope of these enterprises. The significance of the innovation factor shows that the small firms are inclining towards the adoption of ICT. The significance of competitive advantage shows that the small enterprises by ICT adoption gain a competitive advantage over the other firms over their rivals by enhancing the product quality and apply new technologies thereby improving their business performance. The government and industry working under it play a prominent role in promoting and supporting ICT adoption in small enterprises. Management support is an important factor that explains the ICT adoption by SMEs. The significance of this factor shows that the top management is supportive of the adoption of ICT as they assume that this leads to firm growth.

LIMITATIONS AND STUDY FORWARD

The study was limited to Indian SMEs due to the convenience and proximity of the researcher. Hence, future researchers should adopt the qualitative method (interview process) as well to get direct opinions of respondents with the help of interview questions. This method gives an in-depth opinion of respondents that helps the study to get in-depth knowledge about the study. From the findings of the study, it is noted that technological, environmental and organizational factors play an essential role in ICT adoption among Indian SMEs. However, future studies would examine other significant factors in addition to the identified factors in this research. It is also recommended to future studies should focus on establishing its external validity and examining whether the present study outcomes can be replicated in other sectors addition to SMEs. The majority of the SMEs felt insecure in providing associated data to this research even with research assistance that information is only for research purpose and it would be maintained as confidential. Future research may focus on large cross-section and use more random samples to validate the current study findings.

PRACTICAL IMPLICATION OF THE STUDY

This research can be helpful for researchers and policymakers in SMEs. The present research helps them to understand the chief factors like organizational, technological and environmental factors that influence the ICT adoption among SMEs in India. The findings of the study would enable the policymakers to review its existing policies in terms of ICT adoption and also take intervention measures for further development of ICT among Indian SMEs. Future researchers should ensure the relationship between the ICT adoption and development of SME's performance. Further, they may use the variables used in this research and use similar variables for future work with distinct sectors or different sample groups in other countries or make comparisons with India and other countries. Furthermore, the methodology of this study constitutes a comprehensive basis for examining factors that most influence the adoption of SMEs in India, but future researchers may verify, develop and enhance this methodology and its execution. The findings of the study are beneficial to different stakeholders within society.

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